BNL-96474-2011-AB

A NOVEL APPROACH TO PROFILE CLOUD MICROPHYSICS USING DUAL-FREQUENCY RADARS

Dong Huang, Karen Johnson, Yangang Liu, and Warren Wiscombe

35th AMS Radar Meteorology Conference,
Pittsburgh, PA
Sept. 25-30, 2011

Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory

U.S. Department of Energy
Office of Science

ABSTRACT

Single-frequency radar measurements provide insufficient information to retrieve cloud microphysical properties. Existing algorithms usually make use of Z-LWC relationships and work poorly when drizzle or rain drops present. On the other hand, the dual-frequency radar attenuation approach makes no assumptions about the cloud drop size distribution and is based on simple physics. Thus this approach can provide accurate (unbiased) retrieval of cloud LWC. By taking advantage of this simple physics and advanced mathematical inversion techniques, accurate retrieval of vertically resolved cloud LWC can be obtained using operational ARM Ka- and W-band cloud radars operated by the Atmospheric Radiation Measurement (ARM) program. The liquid water path calculated from the radars agrees closely with that from a microwave radiometer, with mean difference of 70 gm^{-2} for precipitating clouds and 30 gm^{-2} for non-precipitating clouds. Comparison with lidar measurements reveals that the dual-frequency retrieval also reasonably captures the cloud base height of drizzling clouds --- something that is very difficult to determine from radar reflectivity alone. We have applied the dual-frequency approach to the ARM radar observations from 2006 to 2008 and have produced a three-year cloud microphysics dataset. Intercomparison results of the dual-frequency and the ARM MICROBASE cloud microphysical retrievals will also be presented.